



NOTES

NORMOCYTIC ANEMIA (DECREASED PRODUCTION)

GENERALLY, WHAT IS IT?

PATHOLOGY & CAUSES

- Insufficient production of erythrocytes AKA red blood cells (RBCs)

CAUSES

- Chronic diseases most common cause (e.g. kidney disease, cancer, rheumatoid arthritis)

SIGNS & SYMPTOMS

- Variable depending on degree of hypoxia, pallor; fatigue; dyspnea; activity intolerance; cardiorespiratory compromise

DIAGNOSIS

LAB RESULTS

- Complete blood count (CBC)
- Peripheral blood smear analysis
- Blood chemistry
- Iron studies
- Genetic testing (rarely)

TREATMENT

MEDICATIONS

- Dietary changes

OTHER INTERVENTIONS

- Supplementation (address iron deficiency)

ANEMIA OF CHRONIC DISEASE (ACD)

osms.it/anemia-of-chronic-disease

PATHOLOGY & CAUSES

- Deficient RBC production due to chronic diseases (e.g. infection, inflammation, malignancy)
- AKA anemia of chronic inflammation

CAUSES

- Inflammatory processes in iron homeostasis
- Systemic inflammation → ↑ circulation cytokines, interleukin 1 (IL1), interleukin

6 (IL6), tumor necrosis factor alpha (TNF alpha), interferon beta (IFN beta), interferon gamma (IFN gamma)

- ↑ hepcidin secretion by liver → ↓ iron absorption from gastrointestinal (GI) tract, ↓ iron sequestration in reticuloendothelial system → ↓ iron available for erythropoiesis
- ↓ secretion of erythropoietin
- Direct inhibition of erythropoiesis
- ↓ erythrocyte lifespan

VISIT...

LANZAROTE
Caliente.COM

RISK FACTORS

- Advanced age, physical trauma

SIGNS & SYMPTOMS

- Hypoxia, pallor; fatigue; dyspnea; activity intolerance; cardiorespiratory compromise
- Variable depending on degree of hypoxia

DIAGNOSIS

LAB RESULTS

- RBCs normochromic, normocytic
- Microcytic, hypochromic RBCs (rarely)
- Leukocytosis
 - Underlying disorder
- Normal/low mean corpuscular hemoglobin (MHC), mean corpuscular volume (MCV)
- Normal mean corpuscular hemoglobin concentration (MCHC)
- Normal/increased red cell distribution width (RDW) normal/increased
- Erythrocyte hypoproliferation
 - Decreased RBC count
 - Mild to moderate decrease in hemoglobin
- Elevated erythrocyte sedimentation rate

(ESR), C-reactive protein (CRP), IL6

- Decreased serum iron levels
- High ferritin
- Decreased serum transferrin saturation
- Decreased total iron binding capacity
- Low serum erythropoietin concentration
- Decreased reticulocyte count
- Bone marrow examination
 - Increased iron in macrophages (related to actions of hepcidin), erythroid precursors

TREATMENT

MEDICATIONS

- Supplemental iron
 - IV more effective than oral iron for systemic inflammation
- Erythropoiesis-stimulating agents (e.g. epoetin alfa, darbepoetin alpha)
 - For severe anemia

OTHER INTERVENTIONS

- Transfusion of packed RBCs
 - For severe anemia

APLASTIC ANEMIA

osms.it/aplastic-anemia

PATHOLOGY & CAUSES

- **Pancytopenia** due to bone marrow hypoplasia/aplasia
- **Idiopathic/inherited/acquired**

CAUSES

- Inherited
 - **Fanconi anemia**; **Shwachman–Diamond syndrome**; familial aplastic anemias; reticular dysgenesis
- Acquired
 - **Immune processes** (e.g. systemic lupus erythematosus, graft-versus-host disease, paroxysmal nocturnal hemoglobinuria)
 - **Drugs** (e.g. cytotoxic cancer chemotherapy, carbamazepine, phenytoin, indomethacin, sulfonamides, chloramphenicol)
 - **Viruses** (e.g. Epstein–Barr, HIV, hepatitis, herpes)
 - **Toxic chemicals** (e.g., solvents, benzene, pesticides)
 - **Ionizing radiation**
- Acquired or idiopathic
 - Insidious onset of **bone marrow hypoplasia/aplasia**, hematopoietic cell loss → ↓ production of cell lineages (thrombocytes, leukocytes, erythrocytes) → peripheral pancytopenia

COMPLICATIONS

- Impairment of blood's immunity, hemostasis, oxygen-carrying capacities

SIGNS & SYMPTOMS

- **Deficient thrombocytes, leukocytes**
 - Shorter lifespan
- **Neutropenia**
 - Increased frequency/severity of

infections

- Neutropenia-related sepsis common cause of death

Thrombocytopenia

- **Mucosal hemorrhage** (e.g. gingival, nares, ecchymosis, petechiae, heavy menstrual flow, occult blood in stool, intracranial hemorrhage)

Anemia

- Pallor, fatigue, dyspnea, activity intolerance, cardiorespiratory compromise

DIAGNOSIS

LAB RESULTS

- **Prolonged bleeding time**
- **Decreased hemoglobin, hematocrit**
- **Absolute neutrophil count decreased**
- **Platelet count decreased**
- **Reticulocyte count decreased**
 - Normal erythrocyte morphology
- **Bone marrow biopsy**
 - Some lymphocytes, plasma cells, stromal elements (e.g. blastoid cells)
 - No increase in blasts/dysplasia

TREATMENT

- Treat underlying cause
 - **Discontinue offending drug treatment**
- Varies by age, severity of symptoms, likelihood of finding donor match

MEDICATIONS

- Manage cytopenias
- Antimicrobials for infections
 - **Medical emergency**: fever + low absolute neutrophil count
- **Growth factors**
 - **Granulocyte colony-stimulating factor**

(G-CSF): frequent/severe infections

- Thrombopoietin (TPO) receptor agonists with immunosuppressive therapy
- Hematopoietic growth factors (rarely)
- Immunosuppressive therapy (IST)
 - Consists of antithymocyte globulin (ATG) + cyclosporin A
 - Administer glucocorticoid with ATG: steroid reduces risk of serum sickness; immunosuppressive properties
 - Cyclosporin A: immunosuppressive
 - Eltrombopag (thrombopoietic agent) to increase platelet count

OTHER INTERVENTIONS

- Hematopoietic stem cell transplant
 - Curative if effective
- Transfusions
 - Platelets, packed red blood cells
 - Increased risk of alloimmunization, graft rejection after bone marrow transplant

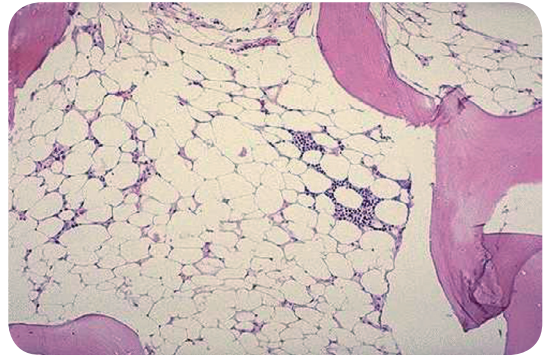


Figure 53.1 A bone marrow biopsy from an individual with aplastic anemia. The bone marrow spaces contain large amounts of fat and minimal hematopoietic tissue is present.